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## Virtual Community Life Cycle: a Model to Develop Systems with Fluid Requirements

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### Abstract

This paper reports the results of an investigation into the life cycle model needed to develop information systems for group of people with fluid requirements. For this purpose, we developed a modified spiral model and applied to the analysis, design and implementation of a virtual community for a group of researchers and organizations that collaborated in a research project and had changing system requirements? The virtual knowledge community was dedicated to support mobilization and dissemination of evidence-based knowledge produced by the **Disability Rights Promotion International Canada (DRPI-Canada)** project.

**Keywords:** Disability rights, Disability Rights Monitoring, Virtual Communities, Knowledge Networks, Knowledge Management

## 1 Introduction

Virtual communities (VCs) have drawn attention of researchers since the inception of the web. Health Virtual Communities (Health VCs) started to take shape in the mid of 1990's. Nevertheless, even though Health VCs share advantages and challenges with other types of VCs some of the advantages they present and the challenges they face are health care specific. Therefore, there is a need to conduct a *Health VCs assessment*. People form virtual communities in order to achieve a certain aim, e.g. playing, chatting, discussing, researching, collaborating, etc. Chat rooms, bulletin boards, and email groups can be considered as virtual communities that allow people to gather and bond. VCs received a visible level of attention from the research community in many disciplines: Computer Science, Sociology, Psychology, and other disciplines. Preece (Preece, 2000) suggests that a virtual community is shaped of: (a) socially interacting *people*, performing special roles or satisfying their needs, (b) a *purpose*, which is the reason behind the community, (c) *policies* to govern people interaction, and (d) a *Computer Systems* that support social interaction.

### 1.1 The problem

While Virtual Communities are well defined and virtual communities modeling has been giving fair attention it is by definition assumed that the *purpose*, aims and objectives of a community members are well defined in advance; it follows that the inherent assumption - from an information systems perspective - is that existing development life cycles can be followed when developing any virtual community. Though, in a fluid environment, such as a situations where participants can change their role/situation/position in their participation, in

multidisciplinary research and collaborative teams, or when the environment is evolving with the time (some external parameters are changing), little – if any - concrete systems objectives, other than the general ‘purpose’ of collaboration, are defined in advance. Indeed, the concrete requirement needs are revealed as the project progresses or even during the community's life. To the best of our knowledge, there has not been an attempt to explore the system development life cycle model needed in projects where requirements are not only not well defined but also fluid and changing in nature. This paper is an attempt to draw the first sketches of such model in the context of a multidisciplinary collaborative virtual knowledge community. Our approach is general and is based on our experience in virtual communities for Human rights monitoring and for health prevention. Most of our examples will be taken from this first domain of application; however some requirements cited will illustrate our second domain of application which contains some additional characteristics (for instance information gathering based on sensed data).

## *1.2 Virtual Communities for Human Rights Monitoring*

### *1.2.1 Framework of Disability*

Disability activists and scholars refer to disability rights as “...the equal effective enjoyment of all human rights by people with disabilities” (Disability Rights Promotion International (DRPI), 2003). The majority consensus is that “disability” is a consequence of negative social conditions rather than an individual’s specific medical impairment (Barnes, Mercer, & Shakespeare, 1999; Fougereyrollas, Cloutier, Bergeron, Côté, & Michel, 1999; Rioux, 1997, 2001; Shakespeare, 1999; Thomas, 2002).

A review of international human rights literature shows that, unlike areas such as women’s rights (Callamard, 1999a, 1999b), disability rights monitoring is relatively underdeveloped (International Disability Rights Monitor, 2004). Mobilization and dissemination of evidence-based knowledge produced through monitoring processes represent the keystone of a holistic approach to monitoring; though integrating different facets of monitoring requires collaboration among a broad range of individuals (including people with disabilities) and organizations. This paper proposes an operational tool that enables dynamic collaboration among project’s participants and knowledge creation and sharing.

Systemic human rights violations against people with disabilities are usually interpreted as issues of service provision rather than being recognized as fundamental rights in order to achieve a society in which people with disabilities are free to fully and equally participate. This requires a conceptualization of disability within a human rights framework that looks at how society marginalizes people, and what strategies are needed to address existing inequalities. It involves moving away from viewing people with disabilities as anomalies towards viewing them as rights holders and equal citizens (Quinn & Degener, 2002).

Rights monitoring is the first step in making this shift possible. While there are a number of international and Canadian human rights commitments and rights monitoring initiatives in the international arena (Disability Rights Promotion International (DRPI), 2003; International Disability Rights Monitor (IDRM), 2004), Canada lacks comprehensive and multi-level analysis of disability rights violations. *DRPI-Canada* project takes a significant step forward in developing a system to monitor the human rights situation of people with disabilities.

### *1.2.2 Mobilization and Dissemination of Evidence-Based Knowledge*

Holistic disability rights monitoring is grounded in on-going communication and sharing of resources, training and methodological approaches among four themes (Policy and Law

Monitoring, Individual Experiences Monitoring, Media Monitoring, Statistics Monitoring). Furthermore, it is essential to build capacity, leadership and knowledge development within the disability community in order to promote greater awareness of disability discrimination and to enable people with disabilities themselves to take ownership of disability rights monitoring. In this context, a complex system is required to facilitate the collaboration of a full range of project participants – researchers, representatives of disability community, policy makers, and general public – and support capacity building within disability community through access to online tools and training resources.

## **2 The Virtual Knowledge Community**

This section describes the design and development process of a Virtual Knowledge Community (VKC) to support, in this case, the holistic disability rights monitoring.

### *2.1 Virtual Communities*

VCs received a visible level of attention from the research community in Computer Science, Sociology, Psychology and other disciplines (Preece, 2000). A virtual community is a form of social system; it inherits some of the social system's characteristics (Weissman, 2000) such as causal reciprocity, purpose, design, roles, circumstances, officers, passion, needs, loyalty, and access. There are different perspectives and different classifications of VCs (El Morr, 2007; El Morr & Kawash, 2007; Stein, Hawking, & Sharma, 2005); though, VCs can be constructed to form a knowledge network. Virtual knowledge Communities are communities where participants capture, access, use, create, and define knowledge (Merali & Davies, 2001), and/or where information is automatically captured to be accessed and shared in-between participants. Our purpose is to design and implement a VC for Knowledge Mobilization, i.e. for knowledge generation, dissemination and use, in the contexts of DRPI and health prevention.

While several virtual communities platform exist, none are general enough to be adapted to our research team objectives in terms of creating dynamic relations among team members, enabling particularly each member (and not only administrators) to create folders and upload/download documents, to co-edit documents and to share files across communities in different levels of granularity: share with one person, one group of people and a whole community. Besides, none of these sites is fully accessible to people with visual disabilities or with limited abilities in the use of computers systems, while accessibility is an essential objective that we strive for in our projects. The VKC is described in detail in the next sections of the paper.

### *2.2 Platform Design and Implementation*

#### *2.2.1 Community Design*

In the field of disability, tools and training resources for evidence-based data collection are scarce as are tools and methods for multiple levels of analysis (i.e. individual, systemic. Development and dissemination of these tools incorporating an e-learning component to a virtual knowledge community in order to support continuous training to develop monitoring skills (online manuals, course guides, books, tools...). Internally, the VKC finally consists of data/document base with links and interactions in-between participants. It should enable participants such as researchers (who are supposed to access and work on this great amount of data) and practitioners (who are supposed to assist concerned people), to *communicate* and *cross-*

*check* their findings, and to *collaborate* around subjects of interest during the research activities. Therefore, members will need a component allowing collaboration to facilitate knowledge creation. Finally, the VKC needs to facilitate the search for information for communities' members. Consequently the VKC was designed into four components allowing (1) knowledge *creation*, (2) knowledge *discovery*, (3) knowledge dissemination and (4) VKC management. The VKC platform was designed to comprise functionalities that support all four components.



Figure 1. A high level view of the components of the collaborative platform

### 2.2.2 Community Platform Implementation

This section presents the implementation choices we have made for the implementation of communities. Open source material has been used throughout the development of the model. The VC platform allows two major **roles** to be played: **Administrator** and **Member**; the members can play three possible roles: **consumer**, **producer** and consumer/producer of information. In the domain of human rights monitoring, information stored and exchanged materializes into documents (in different formats). In the domain of health prevention, information may also consist of raw data captured on or around the patient, or on aggregated data combining several data sources.

The administrator is concerned with the maintenance of the VKC (community and member management), such as creating a new community (figure 2). Several communities can be created, and members can belong to more than one community. Access to a community can be public or controlled. The application portal allows a person to connect and to create his/her own profile. In order to simplify information dissemination, we decided that a *public community* allows people to join without administrator approval since it is designed to disseminate knowledge (research findings, articles, reports, etc.) to the public in the society at large. Members of the *public community* can play the role of *information consumers*. Members of communities, other than the public, are both information producer (e.g. upload documents) and information consumers of information exchanged inside their community (e.g. download documents, consult data).



Figure 2. Creating a new community

Administrators and members of the themes communities can upload and assign each file or each data a “visibility” right (figure 3); that is a member can decide if his/her file is visible by a whole community or a specific person in that community, or any combination of these two possibilities.

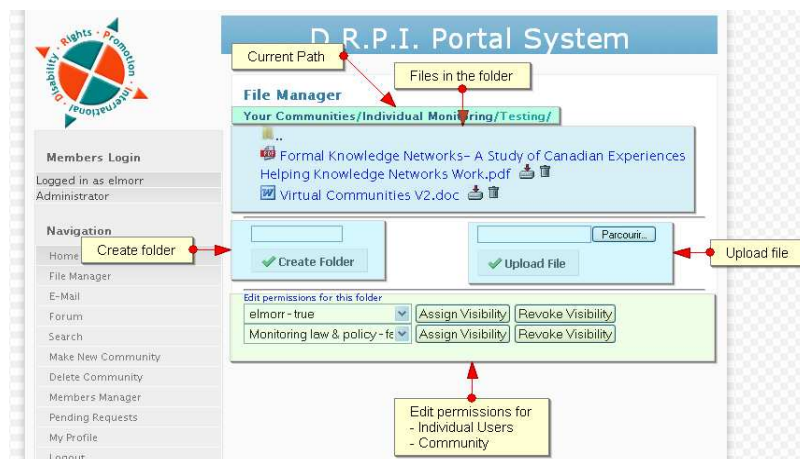


Figure 3. A member assigning “visibility” right (i.e. access rights) to other specific members and/or while communities.

### 2.2.3 Usability and accessibility

To ensure the usability of the portal, we took into account relevant guidelines (U.S. Department of Health and Human Services, 2008) and decided to use a light XHTML W3C compliant template for the layout, with few pictures, to reduce users waiting time and enhance accessibility. The layout is light and easy to scan by the users, a menu on the left gives access to all the features of the portal in one click. The navigation was designed to minimize users’ interaction to access information. Fonts and colors have been chosen for their clarity for people who are not visually impaired. To avoid accessibility issues, we use a layout with few pictures. Thus, most of the content being readable text, accessibility features were implemented easily. We followed the Web Content Accessibility Guidelines (World Wide Web Consortium, 2008) from the W3C; thus, for example, we made menu items accessible using keyboard shortcuts.

### 2.2.4 Knowledge Management

#### 2.2.4.1 Knowledge Management on the Platform

Nowadays, there are 2 main KM trends: People centered, and Information Management/Information Technology Centered KM. Using previous experiences (Davenport, De Long, & Beers, 1998), we used several relevant guidelines to develop our approach in our

healthcare related platforms. As our initiative focuses more on the technical purpose than on a human approach, guidelines regarding technical support were taken in account. Flexible knowledge structure and good usability are important for the success of the initiative. During the development of our platform, those basic guidelines were taken in account, from early specification to late implementation.

Within the platform, numerous users, i.e. producers, will share large amount of documents within and between the communities for consumers. We identified two major issues and defined features to address them. First, searching through a *large* number of documents; therefore, finding relevant documents in the platform regarding to the users interest is identified as of utmost importance. Second, as the information producers are mainly researchers, this platform offers a great opportunity to create cross-theme synergies, open new collaborations or enforce the existing ones. Besides, the platform is designed for the public, and other researchers and organizations at a later stage. The large number of potential contributors will make the discovery of potential common interests between members difficult. Consequently, it is important to facilitate this discovery process.

To address these two issues, we designed a matching feature that enables the system to describe users and documents using metadata in order to (1) notify the user when relevant information has been added to the platform and (2) match users having a “similar” profile. We identified four sequential steps in the process: Information gathering, information extraction, matching, and push mechanism.

During information gathering we gather all the information concerning each member. While during information extraction, keywords are extracted from documents using a text-mining library: RapidMiner (rapid-i.com, 2008). These keywords will complete the documents metadata. These extraction will take place for both documents uploaded by users and the publications they entered to complete their profile. Navigation will also be mined to extract relevant topic of interest (Widyantoro, Loerger, & Yen, 2001; Xiaobin, Jay Budzik, & Kristian, 2000). We trained the RapidMiner model with more than 50 documents related to healthcare. Using this healthcare dedicated text-mining model gives impressive results for keyword extraction. Once the keywords automatically extracted, the owner of the file can decide to manually edit, add or remove keywords from this list (figure 4).

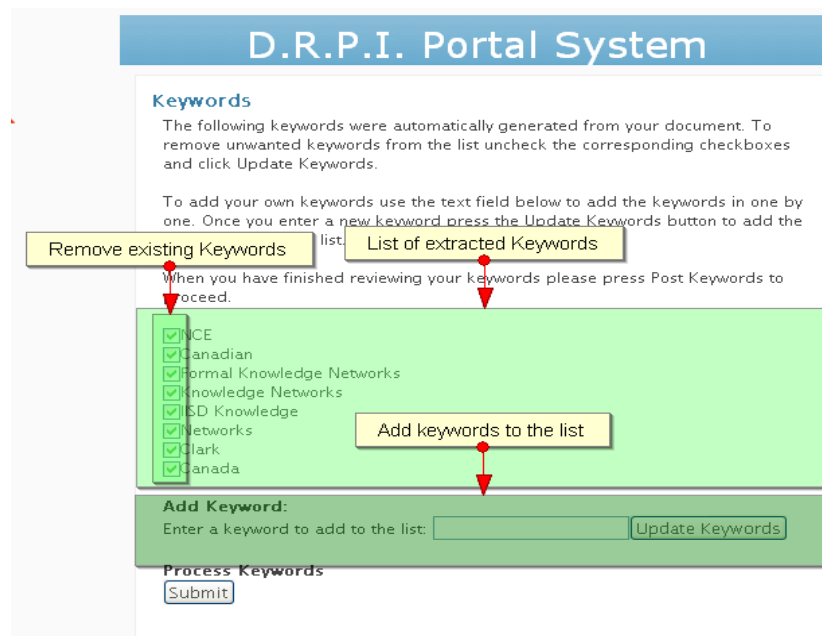


Figure 4: Keyword editing after extraction

Afterward, matching algorithms allowed us to provide a user to document and user to user matching. Both matching algorithms follow the same principle of computing a distance between the gathered metadata. Yu et al. (Yu, Al-Jadir, & Spaccapietra, 2005) presented an algorithm for matching demands and supplies of profiles using a description logic based approach, a similar approach can be used for the user/documents matching.

Multiplying channels of exchanges enhance the global performance of knowledge dissemination; therefore, we've build a forum and a mail system for users. Those communication channels are complementary. Users interaction is thus enhanced, discussion on a paper uploaded in the repository can start and lead to a better understanding or constructive critics.

### 2.2.5 Content management: a Human Rights Monitoring tool

The last aspect of the platform is the management of the content, i.e. human rights monitoring as such. Researchers and NGO (Non-Governmental Organizations) needed a way to collate data from different geographically dispersed sources and then to use it anywhere. Also they were in favor of creating a public community for the dissemination of knowledge to the people. Administrators decided then to create five communities: a public one and four dealing with the four substantive themes of research identified as such for the monitoring of disabilities:

- 1- **Policy and Law Monitoring:** involves the collection of legislation, policy and program data specific to disability rights in. A template is designed to gather data addressing all categories of rights (civil, cultural, economic, political and social). The template serves as an assessment tool, allowing the identification of gaps in legislation and policy and includes cross-references to the relevant provisions of key international human rights treaties. The community members of this theme investigate the policies and laws that are related to disability, on the provincial and federal levels. Researchers in this community are interested in looking into analyzing to which extent the Canadian laws and policies follow the International conventions related to disabilities. This is done through a survey



that is designed to look into each article in an international convention that is related to disability and to see if there are policies and laws and case laws in the provinces and the federation that accommodate that article or that on the contrary hinder its application or simply do not acknowledge it.

- 2- **Individual Experiences Monitoring:** Monitoring of disability rights obligations should include a way to assess the actual situation of people with disabilities in a given country or area. Individual experiences monitoring involves the collection of data through surveys and collect the individual experiences of people with disabilities.
- 3- **Media Monitoring:** The media plays an important role in reflecting and influencing public opinion. Given the role that public opinion and attitudes play in facilitating or hampering the enjoyment of human rights by people with disabilities, a holistic approach to disability rights monitoring also examines the nature and extent of media coverage on disability issues. The media monitoring team monitors the depiction and coverage of disability in the media. The analysis of media stories will take place on two levels - one quantitative (analyzing media coverage) and one qualitative (analyzing the context of media reporting).
- 4- **Statistics Monitoring:** that analyzed governmental statistical data to unveil the kind of data that can be used to draw a picture about the life of people with disabilities.

We've built a tool that organizes the different kinds of data and connects them together. The tool is built around a database designed to gather information from the different communities and to enable searching for data collected from the different communities. At this moment the tool has been used since several months to enter data. Researchers are currently formulating the criteria to be used to search for information; once these criteria are set search capacity will be added online to allow for researchers and later NGOs to use it to produce report about the state of disability rights in Canada. Researchers and disability institutions from around the globe have showed interest in using this tool (we expect it will be used in USA, Sweden, Portugal, Kenya, Cameroon, India, Croatia, and Australia).

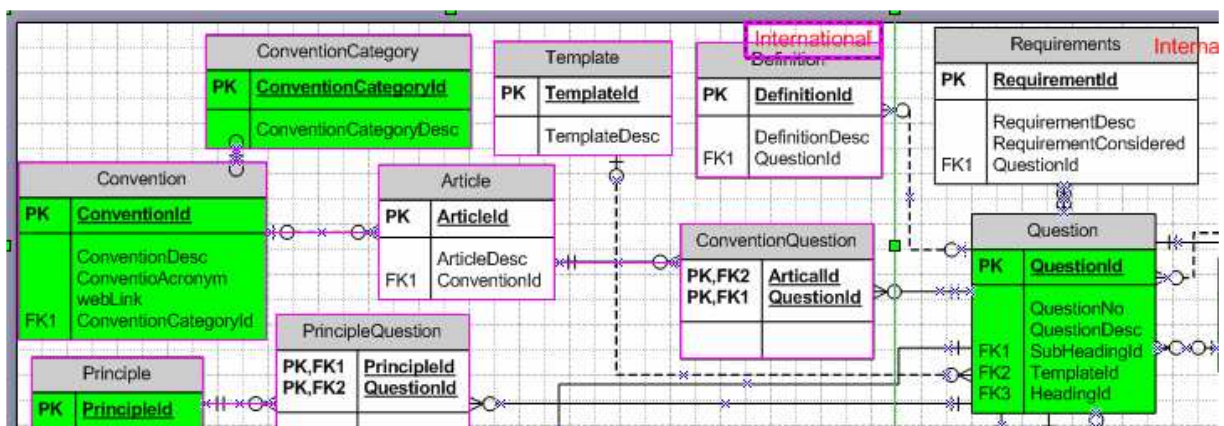


Figure 5. A partial View of the database

The screenshot displays the 'D.R.P.I. Portal System' interface. On the left is a navigation menu with sections: 'Members Login' (showing 'Logged in as elmorrr Administrator'), 'Navigation' (listing Home, File Manager, E-Mail, Forum, Make New Community, Delete Community, Members Manager, Pending Requests, My Profile, Search, E-Library, Policy Database, DRPI Wiki, Logout), and 'adminPage.jsp'. The main content area is titled 'Policy Database' and contains the instruction: 'Please fill out the information below to enter a Canadian Interpretive Policy and all its related information into the database.' The form includes several input fields and buttons: 'Convention Category' (dropdown), 'Convention' (dropdown), 'Name' (text), 'Acronym' (text), 'Web Link' (text), 'Article' (dropdown), 'Overall Question' (dropdown), and 'Question Heading' (dropdown). Each dropdown menu has 'Add', 'Update', and 'Delete' buttons next to it. The 'Add' buttons are highlighted in blue.

Figure 6. Part of a form to enter Law and Policy Monitoring data

### 3 The Model

#### 3.1 Requirements elicitation during the project

The Virtual Knowledge Community that we've presented before replies to a tangible need, i.e. to monitor the application of human rights treaties and international conventions in the Canadian context. This approach is based on a versatile model extensible to other situations.

After each requirement elicitation phase the development team went into analysis, design and prototyping of the virtual knowledge community based on those elicited requirements. In a later stage, community members assessed the prototype together with the changing environment and injected the team with changed or new requirements that were deemed essential in the next step of their collaborative work.

At the end of the development we've noticed that the requirements that were thought to be the most important at the beginning of the project (i.e. file sharing and searching capability) were given less priority and important in a later stage. Community members found that the e-library and the especially the content management tools (the human rights monitoring tools) are the most useful and the most potent to have a tangible impact on their collaborative work. Indeed, users used occasionally the VKC to store files and share them, and disregarded almost completely the email and forum facilities (at least at this stage), they expressed their preference not to have too many login passwords and too many email systems to use at the same time. On the other hand, the e-library and the monitoring tool were enthusiastically welcomed by the researchers and organization partners. Data entry has already started and search criteria are under development.

### 3.2 Model development

Models for system development life cycle already exist.

The traditional '**waterfall**' **model** requires all requirements to be gathered and clarified in order for the design to start, and the implementation to take place (after the design). This model obviously does not fit projects with fluid requirements.

The **spiral model** (Boehmm, 1986) is a more subtle model that relies on iterative prototyping in order to develop a system. This model gives more flexibility in terms of development and input/output tuning, though it needs that the requirements/objectives be defined in advance (at least in terms of processes); indeed, "each cycle of the spiral begins with the identification of the objectives of the portion of the product being elaborated (performance, functionality, ability to accommodate change, etc.)" (Boehmm, 1986).

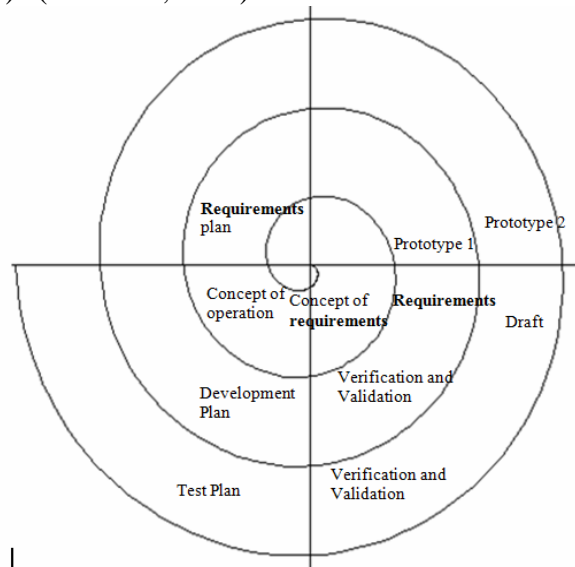


Figure 7: A partial view of the Spiral Model that shows how requirements are to be elicited at the beginning of the life cycle

In a fluid environment, where the needs are changing during the progress of work, functionalities are defined and re-defined, and some may be relegated altogether at the end. The spiral model doesn't seem to explicitly accommodate this situation since the requirements are defined clearly at the beginning of the life cycle. We suggest a modified version of the Spiral Model that takes into consideration the requirements elicitation in a fluid environment. Our model involves a prototyping approach like the spiral model with one difference: at every cycle the requirement may change based on environmental changes (e.g. changes in the community members need) and therefore the Verification and Validation after each phase should involve not only the prototype but also the requirements, which permits to detect arising new needs, or fading former needs (once believed to be important) (Figure 8).

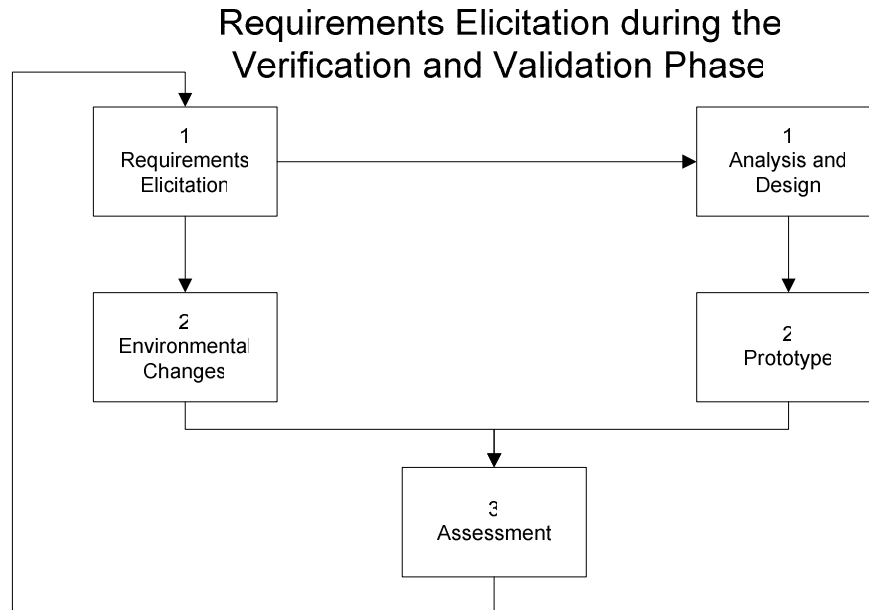


Figure 8: Requirements Elicitation in a Fluid Environment

Once requirements are detected they are communicated to the development team that goes into *analysis and design* and *prototyping*, while the requirements may evolve in parallel due to *environmental changes*. Once a prototype is ready an *assessment* meeting gathers the development team with the community members in order to:

- 1- Assess the prototype (interface, functionality, etc.)
- 2- Elicit new requirements and tune former requirements

Then the process starts all over.

Since iterations end with “verification and validation”, we suggest that the requirements elicitation process, shown in figure 8, be part of the Verification and Validation phase.

We believe that this updated Spiral Model is flexible enough to allow development in a fluid environment where requirements change during the System Development Life Cycle (SDLC).

## 4 Conclusion

We have proposed in this paper the description of a life-cycle of community based applications. Our methodology has been mainly illustrated by the example of a system implementing Virtual Knowledge Communities for the monitoring of human rights. Communities are the right tool to support the creation of information and the exchange of information in-between participants such as researchers and partners, and to mobilize community members, academics, students, as well as the media and policy makers around disability rights. We’ve observed during the project development that some of the formerly believed important requirements were relegated while other requirements appeared to be more important at a later

stage in the project and were included in a subsequent Verification and Validation phase. We have then suggested a modified Spiral Model for information system development in a fluid environment to take into consideration changes in requirements during SDLC. More work should be done to observe if this modified spiral model can be applied in similar contexts.

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